

thus providing a limited spring action. It is also possible to have a retaining ring 9 that is flexible and provides some spring action. This can be accomplished by use of a wave shaped, beveled or slightly conical retaining ring 9. Instead of using a retaining ring 9, a short ring with an outside diameter that is threaded to fit the inside diameter of the connecting ports can be used. It is important that sufficient space remains for the connecting fluid pipe line. The spring action can be provided by an O-ring, a spring washer or a flexible flange.

The above text refers to "two piece" ball valves. However, the invention can also be applied to "three piece" ball valves, as well as plug valves. The valve 100, 102, 106 according to the invention offers at least the following advantages:

1. The disk can be designed so the flow capacity (CV-value) is reduced to a desired value. For example, using the same sequence of CV-values that is typical for HVAC control valves of a globe type.
2. The disk can be designed to provide equal percent flow characteristics or any other suitable flow characteristics.
3. A standard low cost ball valve can be used. The only modification of the basic valve is the groove 14 and the optional recess 15.
4. The disk 8 can be installed or replaced without taking the valve apart.
5. The seats 6 and 7 are not interfered with. The factory adjusted tension and the integrity of the valve remains intact.
6. Because the seats 6 and 7 and the disk 8 are separate parts, each part can be optimized to its function without regard to the other parts.
7. Small inexpensive ball valves are commonly replaced by new valves when the seats are worn out. Because the disk 8 is removable, it is possible to keep the disk 8 and use it in the replacement valve. In doing so, the new valve will have the same flow coefficient and characteristics as the old valve.

The above description is for the purpose of teaching the person of ordinary skill in the art how to practice the present invention, and it is not intended to detail all of those obvious modifications and variations of it which will become apparent to the skilled worker upon reading the description. It is intended, however, that all such obvious modifications and variations be included within the scope of the present invention as defined in the appended claims. The claims are meant to cover the claimed components in any arrangement which is effective to meet the objectives there intended, unless the context specifically indicates the contrary.

What is claimed is:

1. A valve of the type having a casing provided with openings to be connected to a fluid pipe line, wherein at least one of the casing openings forms a groove and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the valve comprising:
 - a plug mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the plug, the plug having an axis of rotation extending transverse to the direction of the fluid flow passageway, the plug being rotatable about the axis of rotation for selectively turning the plug between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path;
 - a disk having an opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having

at least two sides, wherein one of its sides closely conforms with and interfaces with the exterior surface of the plug, wherein the opening of the disk interacts with the fluid passageway extending between the ends of the plug so that different flow characteristics are achieved when the plug is moved between the open and closed positions; and

an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

2. The valve of claim 1, wherein the disk opening is essentially V-shaped.

3. The valve of claim 1, the disk comprising a key, the casing comprising a member for cooperating with the disk key, wherein the disk key mates with the cooperating member of the casing.

4. A valve of the type having a casing provided with openings to be connected to a fluid pipe line, wherein at least one of the casing openings forms a groove and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the casing further comprising a cooperating member, the valve comprising:

a ball mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the ball, the ball having an axis of rotation extending transverse to the direction of the fluid flow passageway, the ball being rotatable about the axis of rotation for selectively turning the ball between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path;

a disk having an essentially V-shaped opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having at least two sides, wherein one of its sides closely conforms with and interfaces with the exterior surface of the ball, the disk comprising a key, wherein the disk key mates with the cooperating member of the casing, wherein the opening of the disk interacts with the fluid passageway extending between the ends of the ball so that different flow characteristics are achieved when the ball is moved between the open and closed positions; and

an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained

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by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

5. The valve of claim 4, wherein the disk is spring loaded and presses against the ball exterior surface.

6. A valve of the type having a casing having at least two parts one of which is screwed into the other and provided with openings to be connected to a fluid pipe line and having a valve chamber therein with at least one inlet and outlet port for defining a fluid flow path through the valve chamber, the valve comprising:

a plug mounted in the valve chamber and having an exterior surface and two ends and a fluid flow passageway extending between the ends and through the plug which is suspended between two seat rings, the plug having an axis of rotation extending transverse to the direction of the fluid flow passageway, the plug being rotatable about the axis of rotation for selectively turning the plug between an open position in which the fluid flow passageway is disposed along the fluid flow path between the inlet and outlet ports and a closed position in which the fluid flow passageway is disposed transverse to the fluid flow path; and

a disk having an opening therein, the disk located inside at least one of the inlet or outlet ports, the disk having at least two sides, wherein one of the sides of the disk closely conforms with and interfaces with the exterior surface of the plug, and wherein the opening of the disk interacts with the fluid passageway extending between the ends of the plug so that different flow characteristics are achieved when the plug is moved between the open and closed positions, and further wherein at least one of the casing openings further comprises a groove and an internal retaining ring sized and shaped to fit at least partially inside the groove, wherein the disk is retained by the internal retaining ring which is at least partially recessed into the groove in one of the casing openings.

7. The valve of claim 6, wherein one of the sides of the disk is concave and has a diameter not greater than the inside diameter of the seat rings.

8. The valve of claim 6, wherein one of the sides of the disk has a diameter not greater than the inside diameter of the inlet and outlet ports.

9. The valve of claim 6, wherein the casing comprises a recess into which the disk fits and further wherein each seat ring is located inside a dedicated recess separate from the recess for the disk.

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10. An insert device attachable to a valving member in a ball valve for providing a predetermined flow condition through the ball valve, said insert device comprising:

an insert member having a substantially convex shape corresponding to an outer surface of a valving member to which said insert member may be attached;

a connector on a periphery of said insert member, said connector being adapted to attach said insert member across a passage through the valving member; and

an elongate slot through said insert member, said elongate slot being adapted to provide a predetermined flow condition through the passage of the valving member to which said insert member is attached.

11. The insert device of claim 10, wherein said connector comprises a plurality of legs extending from said periphery of said insert member, said legs being adapted to engage corresponding pockets in the valving member.

12. The insert device of claim 10, wherein said connector includes an aligning member for providing a predetermined orientation of said elongate opening when said insert member is attached across the passage of the valving member.

13. The insert device of claim 10, wherein said insert member comprises a disk having a diameter corresponding substantially to the passage through the valving member.

14. The insert device of claim 13, wherein said convex shape of said disk corresponds to a portion of a sphere, said sphere having an outer periphery substantially similar to the outer surface of the valving member.

15. The insert device of claim 10, wherein said insert member comprises plastic.

16. The insert device of claim 10, wherein said elongate slot comprises an oblong opening.

17. The insert device of claim 10, wherein said elongate slot comprises a parabolic opening.

18. A ball valve for providing a plurality of predetermined flow conditions therethrough, said ball valve comprising:

a valve housing having upstream and downstream passages extending therethrough, said upstream and downstream passages extending into and out of a valve seat within said valve housing, thereby defining a longitudinal axis through said valve seat;

a valving member rotatably mounted within said valve seat, said valving member having a bore extending therethrough, said bore being alignable with said longitudinal axis, said bore and said upstream and downstream passages together defining a fluid passage through said valve housing;
and

a plurality of disk-shaped inserts individually attachable across said fluid passage, each of said plurality of inserts having an opening therethrough adapted to provide a predetermined flow condition through said fluid passage.

19. The ball valve of claim 18, wherein said valving member and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valving member across said bore, and wherein said plurality of inserts have a convex outer surface corresponding substantially to an outer surface of said valving member.

20. The ball valve of claim 18, wherein said valve seat and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valve seat across said fluid passage adjacent said valving member, said plurality of inserts having a substantially concave inner surface corresponding to an outer surface of said valving member.

21. The ball valve of claim 18, wherein said opening comprises an elongate opening extending along a plane perpendicular to a transverse axis about which said valving member is rotatable within said valve housing.

22. The ball valve of claim 21, wherein said elongate opening comprises a parabolic opening adapted to provide an equal percentage flow characteristic for said valving member.

23. The ball valve of claim 18, wherein said upstream and downstream passages and said bore have substantially cylindrical cross-sections, and wherein said openings of said plurality of inserts have cross-sections adapted to partially block said fluid passage, thereby providing said predetermined flow conditions.

24. The ball valve of claim 18, wherein said valving member is formed from brass or stainless steel.

25. The ball valve of claim 18, wherein said plurality of inserts comprise plastic.

26. The ball valve of claim 18, wherein said plurality of inserts have a diameter corresponding substantially to a diameter of said bore through said valving member.

27. A ball valve for providing a plurality of predetermined flow conditions therethrough, said ball valve comprising:

a valve housing having upstream and downstream passages extending therethrough, said upstream and downstream passages extending into and out of a valve seat within said valve housing, thereby defining a longitudinal axis through said valve seat;

a valving member rotatably mounted within said valve seat, said valving member having a bore extending therethrough, said bore being alignable with said longitudinal axis, said bore and said upstream and downstream passages together defining a fluid passage through said valve housing; and

a plurality of inserts individually attachable across said fluid passage, each of said plurality of inserts having an opening therethrough adapted to provide a predetermined flow condition through said fluid passage;

wherein said valving member and said plurality of inserts include a connector for attaching one of said plurality of inserts to said valving member across said bore; said connector comprising cooperating legs and pockets, said legs and pockets being formed in said valving member and said plurality of inserts.

28. A ball valve for providing substantially linear volumetric flow control, said ball valve comprising:

a valve housing having a passage extending therethrough along a longitudinal axis thereof;

a valving member seated in said valve housing and having a bore extending therethrough alignable with said passage, said valving member being rotatable about a transverse axis

between open and closed positions, whereby said bore and said passage define a fluid passage adjustable between maximum and minimum flow rates as said valving member is rotated between said open and closed positions respectively; and

a volume control member extending substantially across said fluid passage and having a parabolic opening therethrough, said parabolic opening having a parabolic shape adapted to provide substantially equal percentage flow between said maximum and minimum flow rates when said valving member is rotated each degree of movement between said open and closed positions.

29. The ball valve of claim 28, wherein said volume control member comprises a volume control insert that is attachable across said fluid passage.

30. The ball valve of claim 29, wherein said volume control insert and said valving member include a connector adapted to attach said volume control insert to said valving member across said bore.

31. The ball valve of claim 29, further comprising a valve seat within said valve housing, and wherein said volume control insert and said valve seat include a connector adapted to attach said volume control insert to said valve seat across said passage.

32. The ball valve of claim 29, wherein said connector comprises a leg on said volume control insert adapted to be received in a pocket in said valving member.

33. The ball valve of claim 29, wherein said connector includes an aligning member adapted to orient said parabolic opening along a plane perpendicular to said transverse axis when said volume control insert is attached to said valving member.

34. The ball valve of claim 28, wherein said volume control member comprises a set of volume control inserts individually attachable across said fluid passage, each volume control insert including a different size parabolic opening therethrough, whereby said set of volume control inserts provides a range of predetermined flow conditions through said fluid passage.

35. The ball valve of claim 28, wherein said volume control member forms a portion of a valve seat within said valve housing.

